

**Duck Creek Fish Passage Implementation Review**  
**August 29, 2006**  
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On July 25, 2006 an Implementation Monitoring Review was held for the Duck Creek Fish Passage project. The project was initiated to improve fish passage by eliminating a 3 foot drop at the outflow of the U.S. 191 Duck Creek culvert. For many years rainbow trout spawning in Duck Creek, a major spawning tributary to Hebgen Reservoir, have had to jump approximately 2 ½ - 3 vertical feet into fast flowing water at the outflow of the Duck Creek culvert to access spawning areas in upper Duck Creek and its tributaries in Yellowstone Park. Empirical observation revealed about 1 jump in 10 lead to successful passage of the culvert, implying that a fish had to attempt 10 jumps before successfully passing the culvert and expend excessive energy in the process. Forest Service hydrologists and engineers estimated from the discharge-date graph that migrating rainbow trout could negotiate the culvert for about 6-8 days of the 2-month spawning period. While delayed in a large pool below the culvert, fish were at an increased vulnerability to predators such as otters, osprey, and anglers.

To eliminate the drop, a cooperative effort by the Gallatin National Forest (GNF), Montana Fish, Wildlife and Parks (MFWP), Montana Department of Transportation (MDT), and PPL Montana culminated on August 26, 2005 in the construction of a cascade comprised of boulders and fill material which effectively raised the streambed and water level. The area impacted by heavy equipment was reseeded with Idaho fescue in September 2005. Erosion control fabric was applied to a steep, erosion-prone bank. On June 10, 2006, volunteers from the Madison-Gallatin Chapter of Trout Unlimited assisted GNF staff with planting 300 willow cuttings to complete site revegetation.

Objective or mitigation measure and effectiveness definitions include:

Application

- 5- operation exceeds requirements of objective or measure
- 4- operation meets requirements of objective or measure
- 3- minor departure from measure, objective marginally met
- 2- major departure from measure, objective sporadically met
- 1- gross neglect of measure, objective not met

Effectiveness

- 5- improved conditions over pre-project condition
- 4- adequate protection of resources, effective
- 3- minor and temporary impacts on resources, moderately effective
- 2- major and temporary or minor and prolonged impacts on resources or only slightly effective
- 1- major and prolonged impacts on resources or not effective

Evaluation Items - BMP's	source	Applic	Effect	Comments
<b>Duck Creek Fish Passage Objectives</b>				
1. Place boulders and fill at the outflow of the Duck Creek Culvert to raise the streambed and eliminate the jump.	FS Agreement # 04-PA-11011107-027	4	4	A significant pre- to post-project increase in age-0 mountain whitefish was observed through out-migrant trapping.
<b>Duck Creek Fish Passage Mitigation/Rehabilitation Accomplishment</b>				
1. The project will only effect the stream channel immediately downstream of the project.	SPA 124 Permit	4	4	No upstream effects and downstream effects limited to area immediately downstream of project.
2. Surface disturbance will be limited to approved access routes, work areas, and stockpile areas.	SPA 124 Permit	4	4	Heavy equipment use was restricted to preapproved routes.
3. Disturbed areas will be scarified to relieve compaction and revegetated.	SPA 124 Permit	4	4	Completed 2006
4. Construction activities will occur in August and not interfere with spawning fish.	SPA 124 Permit	4	4	Work completed August 2005
5. The project will not alter flow regimes or exacerbate erosion problems.	SPA 124 Permit	4	3-4	Some bank erosion observed immediately downstream of project but may be attributed to high spring runoff.
6. Monitor effectiveness through annual field surveys for at least two years including but not limited to adult and juvenile trapping and redd counts.	FS Agreement # 04-PA-11011107-027	4	4	Monitoring implemented as described in 2006.





**Figure 1.** U.S. Highway 191 Duck Creek culvert with three-foot drop before constructing the fish passage structure.

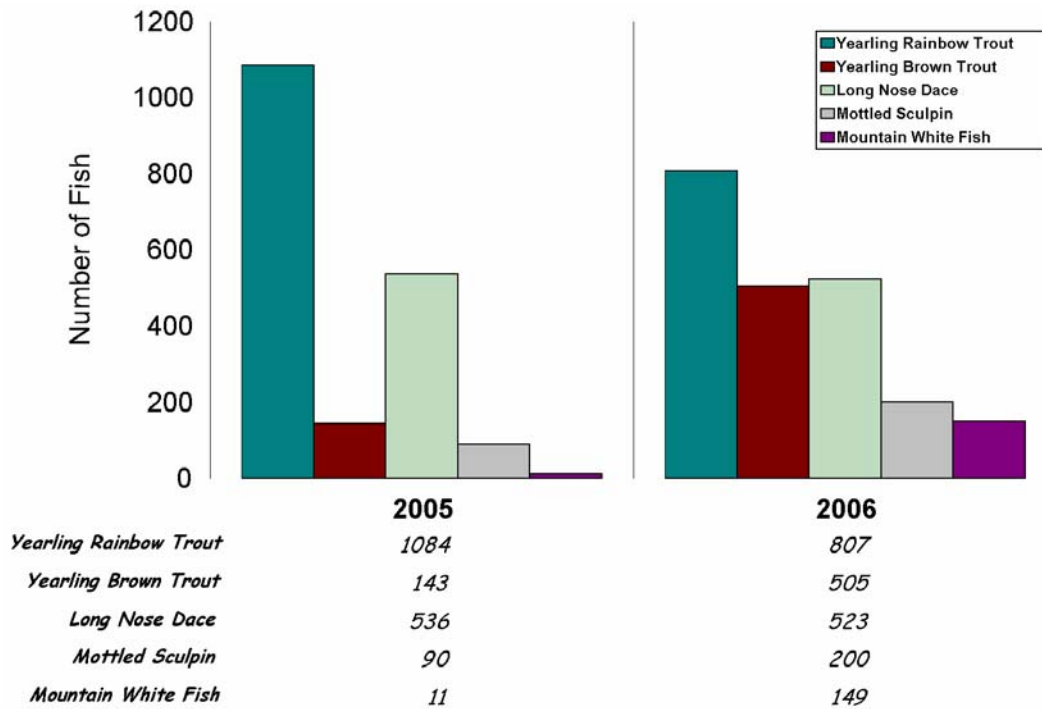


**Figure 2.** Following construction of the boulder cascade, the bottom of the Duck Creek culvert is level with the streambed.

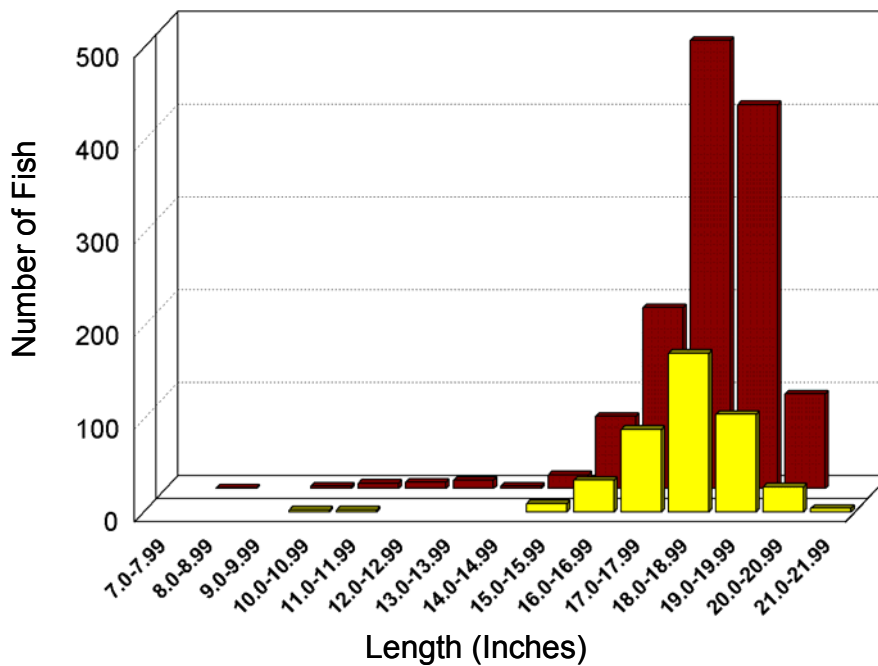




**Figure 3.** Excavator path 45 days after planting willow cuttings. The steep bank to the left of the culvert was treated with coconut mesh erosion control cloth and reseeded with grass in September 2005.



**Figure 4.** Number of out-migrating juvenile fish by species captured in the Duck Creek rotary screw trap during May, June, and July 2005 before the boulder cascade was constructed and 2006 after the cascade was constructed.



**Figure 5.** Length frequency distribution of adult rainbow trout captured upstream of the Duck Cr. culvert during May and June 2005 (yellow bars) before the boulder cascade was constructed and during May and June 2006 (red bars) after the cascade was constructed.

### Conclusions:

1. The Duck Creek fish passage project was successful at eliminating the jump at the outflow of the U.S. 191 culvert and improving fish passage. The number of out-migrating age-0 mountain whitefish and brown trout increased dramatically from 2005 to 2006 most likely due to increased passage of fall spawning adults in 2005 (Figure 4). In addition, adult rainbow trout captured upstream of the culvert in 2006 comprised smaller size classes than those captured in 2005 indicating that smaller fish were able to pass through the culvert after modification (Figure 5). Although passage has been substantially improved, the culvert remains below Forest Service fish passage standards. The culvert has a steep section at the downstream end with velocities which may continue to impair passage of some fish species with lower swimming performance such as mottled sculpins.
2. Due to its close proximity to U.S. Highway 191, the project site is infested with noxious weeds. However, once willow cuttings mature, they may outcompete shade intolerant weed species.
3. Because the construction site could not be dewatered in a cost effective manner, it was imperative to hire a skilled equipment operator who could efficiently manipulate streambed materials below the water's surface. Even though hiring a skilled operator increased project cost estimates, doing so actually reduced construction time, improved the finished product, and likely decreased overall costs.
4. Given the limitations of the culvert that remained after eliminating the drop, pre- and post-project fish population monitoring was critical to rating this project as successful.
5. Cooperation among the GNF, MFWP, MDT, and PPL Montana was essential in overcoming the financial and logistical hurdles of this project.

### Recommendations:

1. Although this project substantially increased fish passage through the U.S. 191 culvert, hydrologic conditions inherent to an undersized culvert with a steep lower section are limiting the full potential for fish passage. Therefore, a bridge should eventually be constructed through continued partnership with MDT to completely pass all fish species and size classes throughout the year.
2. Construction site revegetation should be considered an important fish passage project component and included in design and budget.
3. Erosion is a natural geomorphic process and is usually preferred over unnatural streambank treatments such as rip-rap which actually constrain natural geomorphic process and upset a stream's equilibrium. The streambank downstream of the passage structure was eroding prior to implementing this project and similar eroding banks occur at outcurves further downstream. Therefore it is recommended that no effort should be undertaken to armor the streambank.
4. Intensive monitoring should occur for 3 years post-project followed by a less intensive monitoring effort at a decreased frequency. Monitoring will continue to include adult and juvenile fish trapping as well as establishing a survey benchmark

and cross sections to examine changes in channel morphology and integrity of the structure over time.